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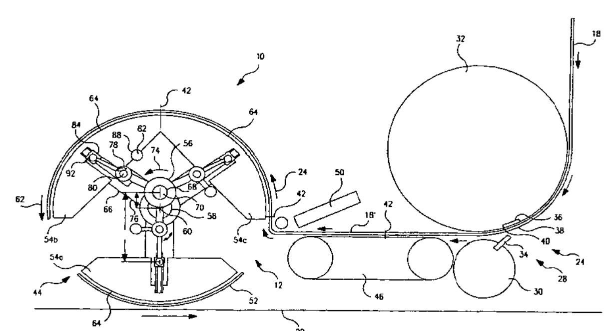
(54) Title: METHOD OF AND APPARATUS FOR SEPARATING DISCRETE ELEMENTS FROM PRE-PERFORATED WEB FOR PLACEMENT ON PRODUCT WEB MOVING AT DIFFERENT SPEED



(57) Abstract: A method and apparatus (10) are provided for separating a discrete element (52) from a first substrate web (18), moving at a first speed, and placing the discrete element (52) on a second substrate web (20), moving at a second speed. The apparatus (10) includes a first station (24), wherein perforations are made in the first substrate web (18), and a second station (44), wherein the discrete element (52) is separated from the first substrate web (18) at a line of perforations and the discrete element (52) is transferred to a position on the second substrate web (20). The first station (24) includes a perforation cutter assembly (28) and conveyer assembly (46). The perforation cutter assembly (28) includes first (30) and second (32) rollers with a cutting blade, with a discontinuous edge, and an anvil surface, respectively, to make perforations in the first substrate web (18). The second station (44) includes a separation and transfer mechanism (12) having separation and transfer segments (54) for separating and transferring the discrete element (52) from the first substrate web (18) to the second substrate web (20). The method includes the steps of: making perforations across a width, at least partially through a thickness, and at predetermined spaced apart intervals along a length of the first substrate web (18); separating the discrete element (52) from the first substrate (18) web along a first line of the perforations; and placing the discrete element (52) on the second substrate web (20).

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METHOD OF AND APPARATUS FOR SEPARATING DISCRETE ELEMENTS FROM PRE-PERFORATED WEB FOR PLACEMENT ON PRODUCT WEB MOVING AT DIFFERENT SPEED

FIELD OF THE INVENTION

The present invention generally relates to a method of and apparatus for manipulating two webs moving at different speeds and more particularly, to a method of and apparatus for separating discrete elements from a first substrate web moving at a first speed, after the first substrate web has been pre-perforated, and placing the discrete element separated from the first substrate web onto a second substrate web moving at a second speed.

BACKGROUND OF THE INVENTION

Conventionally, absorbent articles for personal care usages, such as infant diapers, child training pants, adult incontinence garments, feminine sanitary napkins, and similar products for storing fluid bodily exudates, have been manufactured on an assembly line. The assembly line manufacture of these absorbent articles has involved manipulating first and second substrate webs moving at first and second different speeds, respectively. A number of machines and processes are known in the prior art for cutting discrete components from a first substrate web, traveling at a slower speed, and transferring the cut discrete components to a second substrate web, traveling at a faster speed. Many of these known machines and processes provide for the cutting of the discrete components at a point separated from the mechanism for transferring the cut component to the second web. In this situation, it often becomes difficult to maintain proper positioning and orientation of the cut component between the cutting operation and the placement of the cut component on the second substrate web. This problem is exacerbated in those cases where placement and orientation of the cut component on the second web are critical.

A solution to this problem has been proposed in the prior art which involves the cutting of the discrete components from the first substrate web after the first substrate web has been placed on a transfer roller. Indeed, the use of a cutting and transfer mechanism, such as an oscillating cam adjusted roller or OSCAR module, is taught in U.S. Patent No. 5,716,478 (hereinafter "the '478 patent"), issued to Boothe et al. on February 10, 1998, and entitled Apparatus And Method For Applying Discrete Parts Onto A Moving Web. The '478 patent discloses how discrete elements

or component parts of an absorbent article being manufactured, such as absorbent cores or inserts, leg elastics, waist elastics, tapes, and other fasteners including hook and loop materials or snaps, on a first continuously moving substrate web, may be cut from the first substrate web and applied to a second continuously moving substrate web of interconnected articles which is moving at a different speed on an assembly line.

The '478 patent also discloses that the cutting of the discrete elements or component parts from the first substrate web is most preferably accomplished by use of a knife roll. The knife roll includes a plurality of cutting edges rotating about a shaft. The cutting edges of the knife roll cut the first substrate web into discrete elements or component parts at the junction between adjacent transfer segments of a transfer mechanism or OSCAR module.

However, the apparatus and method of the '478 patent have certain drawbacks or problems associated therewith, because the cutting of the first substrate web into discrete elements or component parts involves competing concerns. On one hand, it is advantageous that the discrete elements or component parts are not cut from the web too early in the process in order to maintain the integrity of the web and thus, allow for easier transportation of the web from place to place. On the other hand, not cutting the discrete elements from the first substrate web early enough creates complications with adhesive application, if necessary, and also the location of the cutting equipment becomes difficult due to the confined space within which it must be positioned.

The '478 patent teaches that the cutting of the first substrate web into discrete elements occurs at the junction between two adjacent transfer segments of the OSCAR module. This creates problems because cutting is typically done against a surface, such as an anvil, but as there is no anvil to cut against on the OSCAR module, if the rotation of the knife roll gets out of phase with the separation of the transfer segments, the knife roll may nick or damage the outer arched surface of the transfer segment. Thus, the useful life of the transfer segments may be shortened causing great expense for labor and parts in replacement and also down time of the assembly line.

It would be desirable if a method of and apparatus for separating a discrete element from a first substrate web moving at a first speed on an assembly line could be provided, without the need for a cutting device at a cutting station to

cut the discrete element from the first substrate web, prior to placement of the discrete element on a second substrate web moving at a second speed.

SUMMARY OF THE INVENTION

In response to the discussed difficulties and problems encountered with respect to the prior art devices and methods, the present invention provides a method of and an apparatus for separating a discrete element from a first substrate web and placing the discrete element on a second substrate web moving at a different speed than the first substrate web.

In one aspect of the present invention, an apparatus for separating a discrete element from a first substrate web moving at a first speed and applying the discrete element onto a second substrate web moving at a second speed is provided. The apparatus includes a first station for making perforations across a width, at least partially through a thickness, and at predetermined spaced apart intervals along the first substrate web. The apparatus also includes a second station for separating the discrete element from the first substrate web at a first line of the perforations and then, placing the discrete element on the second substrate web.

In another aspect of the present invention, a method of separating a discrete element from a first substrate web moving at a first speed and applying the discrete element onto a second substrate web moving at a second speed is provided. The method includes the steps of: making perforations across a width, at least partially through a thickness, and at predetermined spaced apart intervals along a length of the first substrate web; separating the discrete element from the first substrate web along a first line of the perforations; and placing the discrete element on the second substrate web.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

The present invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention and the accompanying drawings wherein like numerals represent like elements. The drawings are merely representative and are not intended to limit the scope of the appended claims.

FIG. 1 is a representative view of a first embodiment of the apparatus aspect of the present invention.

FIG. 2 is a representative view of a second embodiment of the apparatus aspect of the present invention.

FIG. 3 is a front view of a discontinuous cutting blade with a discontinuous cutting edge for making perforations.

FIG. 4 is an enlarged view of circle 4-4 of FIG. 3 showing details of the discontinuous surface of the discontinuous cutting blade.

FIG. 5 is a representative view of a typical absorbent article, such as an infant disposable diaper or and an adult incontinence garment.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a method of and apparatus for separating a discrete element from a first, pre-perforated substrate web moving at a first speed and placing the discrete element that has been separated from the first substrate web onto a second substrate web moving at a second speed. The method and apparatus are particularly useful in the manufacture of absorbent articles, such as infant diapers, child training pants, adult incontinence garments, feminine sanitary napkins, or similar products for storing fluid bodily exudates, wherein a discrete element or component part, such as an absorbent core or insert member and a waist elastic member, needs to be separated from a first, pre-perforated web moving at a first speed and then, the discrete element or component part of the absorbent article needs to be applied to a second, product web of interconnected absorbent articles. However, it is readily apparent that the method and apparatus would be suitable for applying any part, separated from one web, to a substrate web.

Referring to FIGS. 1 and 2, first and second embodiments, respectively, of the apparatus **10** of the present invention are shown schematically. It should be noted that both the first and second embodiments of the apparatus **10** of the present invention employ a separation and transfer mechanism **12**. The separation and transfer mechanism **12** is most preferably an oscillating cam adjusted roller or OSCAR module as is taught in the '478 patent discussed above and as will be described in more detail below.

The first embodiment of the apparatus **10** of the present invention, as illustrated schematically in FIG. 1, is particularly well suited for the manufacture of an absorbent article **14** (which will be described in more detail below in reference to FIG. 5), such as an adult incontinence garment, wherein a plurality of a certain component of the incontinence garment, such as the absorbent core or insert member **16**, are transported on a first substrate web **18**, which is moving at a first speed on an assembly line, and must somehow be separated from the first substrate web **18** and then, transferred and positioned on a second substrate web **20**, such as a plurality of interconnected incontinence garment products or panties, which is moving at a second speed through the assembly line.

The second embodiment of the apparatus **10** of the present invention, as illustrated schematically in FIG. 2, is particularly well suited for the manufacture of an absorbent article **14**, such as an infant diaper, wherein a plurality of a certain component of the diaper, such as a pre-stretched waist elastic members **22**, are transported in a pre-stretched orientation on a first substrate web **18**, which is moving at a first speed on an assembly line, and must somehow be separated from the first substrate web **18** and then, while remaining in the stretched orientation, be transferred and positioned onto a second substrate web **20**, such as a plurality of interconnected adult incontinence garment products or panties, which is moving at a second speed through the assembly line.

In FIG. 1,the first embodiment of the apparatus **10** of the present invention shows the unperforated first substrate web **18** as preferably initially fed from above to the apparatus **10**, from a supply roll (not shown), although other initial orientations of the supply roll (not shown) are possible. The unperforated first substrate web **18** is transported downwardly on a conveyor assembly (not shown) to a first station **24**.

In FIG. 2, the second embodiment of the apparatus **10** of the present invention shows the unperforated first substrate web **18** as preferably initially located somewhere below the apparatus **10**, although other initial orientations are possible. The unperforated first substrate web **18** is transported upwardly by means of a web feed drive roller **26** to the first station **24**.

In both the first and second embodiments shown in FIGS. 1 and 2, the first station **24** includes a perforation cutter assembly **28**. The term "perforation" is defined as a series of small incisions, slits, openings, or holes of any shape

(whether round, rectangular, or other) alternating with spaces of uncut material to define a line along which separation is facilitated. Although the incisions, slits, openings, or holes of the perforations may be entirely through the thickness of the material in which they are placed, they may also be only partially through the thickness as long the deepness of the incision, slit, opening, or hole into the thickness of the material is enough to facilitate easier separation.

The perforation cutter assembly **28** of both the first and second embodiments include first and second rollers **30**, **32**. In the first embodiment shown in FIG. 1, the first roller **30** is shown as being of a much smaller diameter than the diameter of the second roller **32**, although the first and second rollers **30**, **32** may be of equal or nearer equal diameters. In the second embodiment shown in FIG. 2, the first roller **30** has only a slightly smaller diameter than the diameter of the second roller **32**, although the diameters of the first and second rollers **30**, **32** may be more disproportionate, depending upon the desired distance between perforations along the length of the first substrate web **18**.

In both the first and second embodiments of the apparatus **10** of the present invention shown in FIGS. 1 and 2, the first roller **30** has at least one discontinuous cutting blade **34** mounted at an angle thereon and extending outwardly from the circumference thereof. The term "discontinuous" is defined as not continuous, or in the context of an edge, an edge that alternatingly continues for some distance and then lapses for some distance such as a crenellated, sinusoidal or corrugated edge, wherein the alternating ridges and grooves may be squarish, triangular, etc. rather than curved. The second roller **32** has a plurality of anvil members **36**, of the type having relatively flat surfaces **38** for being cut against by a blade or knife, mounted so as to be partially embedded in the outer circumference thereof with the flat surface **38** extending slightly outwardly.

Referring to FIGS. 3 and 4, the discontinuous cutting blade **34** used to make perforations in the first web **18** is illustrated. The discontinuous cutting blade **34** is preferably formed from a flat piece of metal plate and is most preferably rectangular in shape so as to have two short sides and two long sides. The two long sides have discontinuous cutting edges **40** along the outer periphery thereof. The discontinuous cutting edges **40** are somewhat "toothed" in appearance. Indeed, in the preferred embodiment each "tooth" is approximately 0.050" high and 0.040" wide and spaced apart at 0.025" wide intervals, although these dimensions may

change depending upon the type of material to be perforated and other variables. It should be noted that the discontinuous cutting edges **40** of the discontinuous cutting blade **34** are designed to leave a clean edge upon separation and to maintain a balance between integrity of the pre-perforated web **18'** up to the point of separation and substrate appearance after separation from the web **18'**. For example, a web requiring approximately 7 pounds per linear inch breaking tensile strength would require a discontinuous cutting blade **34** with discontinuous cutting edges **40** spaced about 0.025" to 0.040" apart to achieve a resultant separation tear strength of 2 pounds per linear inch. Most advantageously, the discontinuous cutting blade **34** is preferably symmetrical across its lateral and longitudinal central axis so that the orientation of the discontinuous cutting blade **34** may be changed for cutting along a different part of the discontinuous cutting edge **40** when the discontinuous cutting blade **34** becomes dull to save money in replacement costs.

The second roller **32** of the first and second embodiment of the apparatus **10** of the present invention has at least one anvil member **36** of the type having a flat surface **38** for being cut against by a blade or knife. The first and second rollers **30**, **32** are timed to rotate with respect to each other so that the discontinuous cutting edge **40** of the discontinuous cutting blade **34** of the first roller **30** contacts the flat surface **38** of the anvil member **36** of the second roller **28** in order to make lines of perforations **42** across the width of the first substrate web **18**.

After the first substrate web **18** has passed through the perforation cutter assembly **28** of the first and second embodiments of the apparatus **10** of the present invention, a pre-perforated first substrate web **18'** is formed which must be transported from the first station **24** to a second station **44**. As is shown in FIG. 1, the first embodiment of the apparatus **10** of the present invention uses a conveyor assembly **46** to transport the pre-perforated first substrate web **18'** from the first station **20** to the second station **44**.

With respect to the second embodiment of the apparatus **10** of the present invention as is shown in FIG. 2, a web guide **48** may be located between the first and second stations **24**, **44**. The web guide **48** is used to help keep the pre-perforated first substrate web **18'** centered during its conveyance through the

assembly line. Alternatively, if a web guide **48** is provided, it may be located at some point prior to the first station **24**.

With respect to both the first and second embodiment of the apparatus **10** of the present invention as is shown in FIGS. 1 and 2, an adhesive applicator assembly **50** may be located between the first and second stations **24**, **44**. The adhesion applicator assembly **50** is used to apply adhesive to a first outer surface of the pre-perforated first substrate web **18'**, which first outer surface is the surface of the pre-perforated first substrate web **18'** which does not come into contact with the outer periphery of the separation and transfer mechanism **12** located at the second station **44**.

Both the first and second embodiments of the apparatus **10** of the present invention as shown in FIGS. 1 and 2, respectively, include a second station **44** is where discrete elements or component parts **52** are separated from the pre-perforated first substrate web **18'** and then, transferred and positioned onto the second substrate web **20** by the separation and transfer mechanism **12**.

The separation and transfer mechanism **12** is most preferably an oscillating cam adjusted roller or OSCAR module as taught in U.S. Patent No. 5,716,478 issued to Boothe et al. on February 10, 1998. The separation and transfer mechanism **12** may include a plurality of separation and transfer segments **54**. More particularly, the illustrated example of the separation and transfer mechanism **12** in FIGS. 1 and 2 have first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. However, it should be readily understood that the apparatus **10** may include any number of separation and transfer segments **54** depending upon the different web speeds and desired placement and size of the discrete element **52**. For instance, a working model of the apparatus **10** of the first embodiment built by applicant had a separation and transfer mechanism **12** with five separation and transfer segments.

The first, second, and third separation and transfer segments **54a**, **54b**, and **54c** are configured to receive the pre-perforated first substrate web **18'** from the conveyor assembly **46** at the first station **24**, separate a discrete element **52** from the pre-perforated first substrate web at a line of perforations, and apply the discrete element **52** to the second substrate web **20**. Each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is rotated by a drive ring **56** such that the surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is substantially equal to the speed of the

first substrate web **18** as the discrete elements **52** are received and substantially equal to the speed of the second substrate web **20** as the discrete elements **52** are applied.

Each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is coaxially supported and rotatably connected to a common idler shaft **58** on a first axis **60**. First, second, and third separation and transfer segments **54a**, **54b**, and **54c** are rotated about the first axis **60** in the direction indicated by the arrow **62** associated therewith. Each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** include an outer surface **64** and a support member **66** which is rotatably connected to the idler shaft **58** such that each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** can be rotated independently. The radial inner end of the support member **66** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may be rotatably connected to the idler shaft **58** by any technique known to those skilled in the art such as, for example, using conventional bearings. Similarly, the other components of the apparatus **10** of the present invention can be rotatably connected together employing such conventional techniques.

The outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** travels along and defines a common circumferential path that allows the discrete elements **52** to be received and applied to the second substrate web **20**. The outer surface **64** is configured to receive at least one discrete element **52** and apply the discrete element **52** to the second substrate web **20** each revolution. For example, if the apparatus **10** of the present invention is being used to apply pre-stretched waist elastic members **22** to a continuously moving product web of interconnected disposable diapers as in the second embodiment to be explained in more detail below, the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may be configured to receive the two segments of pre-stretched waist elastic members **22** and apply the waist elastic members **22** along the waist opening regions on each diaper. The outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may also be configured to rotate the discrete elements **52** before the discrete elements **52** are applied to the second substrate web **20**. For example, the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may be connected to a

turning mechanism (not shown) which is configured to rotate the discrete elements **52** before being applied. Such a configuration is particularly desirable for applying waist elastic members **22** to a continuously moving web of interconnected disposable diapers.

The outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may be textured to define a surface roughness which assists in gripping and maintaining the discrete elements **52** on the outer surface **64**. Such a configuration is particularly desirable when the discrete elements **52** are elongated waist elastic members **22**. As used herein, the term "surface roughness" is the surface roughness of a material as determined by conventional methods known to those skilled in the art. One such method utilizes a profilometer to detect the surface roughness. The stylus of the profilometer is drawn across the textured surface a distance of 1.27 centimeters (hereinafter "cm"). The profilometer measures the number of Peaks and valleys on the surface as well as the magnitude of each. The profilometer automatically calculates the surface roughness as a Roughness Average (RA) which is the arithmetic average of the measured profile height deviations taken within the sampling length and measured from the graphical centerline. Outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may define a surface roughness of at least about 3 micrometers (hereinafter "μm"). Desirably, at least about 10 μm and more desirably, at least about 15 μm. For example, the outer surface **64** may have a surface roughness of from about 5 μm to about 50 μm and desirably from about 10 μm to about 20 μm. To achieve the surface roughness, the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may also include a coating such as a plasma coating as are known to those skilled in the art. When the discrete elements **52** being received and applied by first, second, and third separation and transfer segments **54a**, **54b**, and **54c** are elongated elastic parts, it is desirable that the outer surface **64** have a plasma coating which defines a surface roughness of at least about 5 μm. To assist in maintaining the discrete elements **52** on the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**, the outer surface **64** may also include a plurality of holes therein through which a relatively low pressure or vacuum can be drawn. The use of such vacuum is particularly desirable when the apparatus **10** of the present invention is used to

receive and apply discrete elements **52** which are elongated elastic parts such as waist elastics for application on disposable diapers. The number and pattern of the holes through which the vacuum may be drawn may vary depending upon the size of the first, second, and third separation and transfer segments **54a**, **54b**, and **54c**, the shape and size of the discrete elements **52**, and the desired location of the discrete elements **52** on the first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. If vacuum is desired, typically, only a relatively small amount of vacuum is needed to assist the rough outer surface **64** of the first, second, and third separation and transfer segments **54a**, **54b**, and **54c** to maintain the discrete elements **52** on the outer surface **64**. For example, typically no more than about 20″ of water and desirably only from about 0″ to about 10″ of water are required to assist the rough outer surface **64**. Applicants have discovered that, when compared to conventional methods which use relatively high levels of vacuum to grip the parts, the combination of the rough outer surface **64** and the relatively low level of vacuum of the apparatus **10** of the present invention provide improved control and placement of the discrete elements **52** on the second substrate web **20** at a relatively lower cost.

If vacuum is desired, the vacuum may be drawn through the holes in the outer surface **64** by one or more sources of vacuum using conventional techniques for drawing a vacuum as are known to those skilled in the art. The vacuum to each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may also be controlled such that a vacuum is only being drawn from the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** for the period of its rotation when the discrete elements **52** are located on the outer surface **64**. For example, the vacuum may be activated just prior to the discrete elements **52** being received and inactivated immediately after the discrete elements **52** are applied to the second substrate web **20**.

The dimensions of separation and transfer segments **54** will vary depending upon the desired number of separation and transfer segments to be used and the size and shape of the discrete elements **52** being transferred. For example, when the apparatus **10** includes first, second, and third separation and transfer segments **54a**, **54b**, and **54c** as representatively illustrated in FIGS. 1 and 2, each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may have an outer peripheral arc length spanning of from about 20° to about 120°, an outer

radius of from about 5 cm to about 50 cm, and a width of from about 5 cm to about 40 cm.

Both the first and second embodiments of the apparatus **10** of the present invention, as representatively illustrated in FIGS. 1 and 2, respectively, further comprises a drive ring **56** which is configured to rotate each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at a variable speed. The inner radial end of the drive ring **56** is rotatably connected to a fixed shaft **68** on a second axis **70**. The drive ring **56** is configured to be rotated at a constant speed about the second axis **70** by a driving means (not shown) in the direction indicated by the arrow **74** associated therewith. The driving means (not shown) may include a motor operatively connected through suitable gearing and drive belts to the drive ring **56**. In use, the motor rotates the drive ring **56**, which in turn rotates each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at the desired variable speed.

To provide the desired variable speed of each first, second, and third separation and transfer segments **54a**, **54b**, and **54c**, the second axis **70** of the drive ring **56** is offset from the first axis **60** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** by an offset distance **76**. The offset distance **76** between the first axis **60** and the second axis **70** may be any distance which provides the desired variations in, the speed of the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. For example, the offset distance **76** may be at least about 0.1 cm, desirably from about 0.1 cm to about 7.5 cm and more desirably from about 2.5 cm to about 5 cm.

The apparatus **10** further comprises at least one coupler arm **78** which is pivotally connected to the drive ring **56** about a pivot point **80**. The apparatus **10** typically includes one coupler arm **78** for each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. Accordingly, in the apparatus **10** as representatively illustrated in FIGS. 1 and 2 which includes first, second, and third separation and transfer segments **54a**, **54b**, and **54c**, three coupler arms **78** independently connect the drive ring **56** to each respective separation and transfer segment **54**. The coupler arms **78** are pivotally connected to the drive ring **56** about pivot points **80** which are selectively located to provide the desired speeds for each of first, second, and third separation and transfer segments **54a**, **54b**, and

54c. The pivot points **80** for the coupler arms **78** are located the same distance radially outwardly from second axis **70** of drive ring **56**. In such a configuration, the pivot points **80** rotate at a constant speed along a common circumferential path as the drive ring **56** is rotated at a constant speed. The coupler arms **78** may be pivotally connected to the drive ring **56** by conventional means known to those skilled in the art. For example, a bearing which is commercially available from SKF Industries, Inc., a business having offices located in King of Prussia, Pa., may be used to pivotally connect the coupler arms **78** to the drive ring **56** at the pivot points **80**.

Each coupler arm **78**, as representatively illustrated in FIGS. 1 and 2, includes a cam end **82** and a crank end **84** which extend radially outward from the pivot point **80**. The cam end **82** and crank end **84** are designed to remain at a fixed angle relative to each other. For example, a first line extending through the pivot point **80** and the cam end **82** and a second line extending through the pivot point **80** and the crank end **84** may define an angle of from about 30° to about 180° and desirably from about 60° to about 120° to provide, the desired variable speed. The cam end **82** of each coupler arm **78** is configured to follow a predetermined curvilinear path and the crank end **84** of each coupler arm **78** is slidably connected to one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. As the drive ring **56** is rotated, the cam end **82** of each coupler arm **78** is guided along the curvilinear path and the crank end **84** of each coupler arm **78** slidably engages one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**, thereby pivoting the coupler arm **78** about the pivot point **80**. The pivoting of the coupler arm **78** and the offset crank motion of the drive ring **56** vary the effective drive radius **86** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** and rotate each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at a variable speed. Preferably, each coupler arm **78** is configured to pivot at least about 5° and desirably from about 20° to about 60° as the drive ring **56** is rotated to provide the desired changes in the effective drive radius **86** and rotation of each first, second, and third separation and transfer segments **54a**, **54b**, and **54c**.

The cam end **82** of each coupler arm **78** may be guided along the curvilinear path by any means known to those skilled in the art. The cam end **82** may include a cam follower **88** which is connected to the radially outward end of the cam end **82**

and configured to follow the profile of a cam mechanism (not shown). In such a configuration, the profile of the cam mechanism (not shown) can be readily changed to change the desired speed output. Suitable cam followers **88** and cam mechanisms (not shown) are known to those skilled in the art. For example, the cam follower **88** may be one commercially available from INA, a business having offices located in Fort Mills, N.C., under the trade designation NUKR 35. A suitable cam mechanism (not shown) may be manufactured with any desired profile by methods known to those skilled in the art.

The crank end **84** of each coupler arm **78** may be slidably connected to each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** by any means known to those skilled in the art. An inwardly grooved slide member **92** may be pivotally connected to the radially outward end of the crank end **84** of each coupler arm **78**. Each slide member **92** is configured to slide along a rail member **76** which is connected to the support member **66** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. Each rail member **94** projects outwardly from one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** and may be positioned on one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** in any alignment which provides the desired speeds thereof. Suitable complementary slide members **92** and rail members **94** are known to those skilled in the art. For example, the slide member **92** and rail member **94** combination may be one commercially available from Star Linear Systems, Inc., a business having offices located in Charlotte, N.C., under the trade designation Ball Rail System-1651-15. Alternatively, the crank end **84** of each coupler arm **78** may include a groove therein which is configured to slidably engage a cam follower **88** located on one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**

The apparatus **10** may further include a turning mechanism (not shown) for rotating the discrete elements **52** before they are applied to the second substrate web **20**. Any mechanism which provides the desired rotation of the discrete elements **52** can be used. For example, one suitable mechanism is a barrel cam as are well known to those skilled in the art. Thus, in use, the discrete elements **52** may be received by one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** while oriented in one direction and subsequently, be rotated by the turning mechanism (not shown) before being applied to the second substrate web **20**.

The turning mechanism (not shown) can be configured to rotate the discrete elements **52** any amount before they are applied. For example, the turning mechanism (not shown) may be configured to rotate the discrete elements **52** from about 1° to about 180° and desirably from about 1° to about 90° before they are applied depending upon the desired orientation of the discrete elements **52** on the second substrate web **20**. Such a turning mechanism (not shown) is particularly useful when applying waist elastics to a product web of interconnected disposable absorbent articles.

It will be apparent that the discrete elements **52** may be adhered to the second substrate web **20** by means of an adhesive applied in a selected pattern to the surface of the discrete elements **52**, or by any other suitable means for adhering the discrete elements **52** to the second substrate web **52**.

The use of the combination of the offset drive ring **56** and pivoting coupler arm **78** to drive the first, second, and third separation and transfer segments **54a**, **54b**, and **54c** in the apparatus **10**, as representatively illustrated in the various aspects of the invention described above, provides an inexpensive and adaptable method for separating discrete elements or component parts **52** from a pre-perforated first substrate web **18'** traveling at a first speed and applying the discrete elements or component parts **52** to a second substrate web **18** traveling at a second, different speed. The design of the drive ring **56** and coupler arm **78** can be analytically determined to obtain the desired output function which can include variable angular velocities with fixed speed dwells. For example, the speed profile of an example of an apparatus **10** has first, second, and third separation and transfer segments **54a**, **54b**, and **54c** which can be configured to rotate through a period of low speed dwell, acceleration, high speed dwell, and deceleration, in each revolution.

As the offset drive ring **56** rotates at a constant speed, each coupler arm **78** pivots about the pivot points **80** as the cam end **82** of the coupler arm **78** is guided along the profile of the cam mechanism (not shown) and the crank end **84** of the coupler arm **78** slidably engages one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. As a result, the effective drive radius **86** for each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is varied thereby varying the surface speed thereof independently. The periods of acceleration and deceleration of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** are provided by the offset crank motion which

results from the second axis **70** of the drive ring **56** being offset from the first axis **60** of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. Whereas, the periods of low speed dwell and high speed dwell are provided by the pivoting action of each coupler arm **78** about the pivot points **80** as the drive ring **56** is rotated. As such, the combination of the offset drive ring **56** and the pivoting coupler arm **78** of the apparatus **10** of the present invention can provide both the desired changes in speed and the desired periods of constant speed to effectively receive and apply the discrete elements **52** onto the second substrate web **20** in the desired spaced apart locations.

As compared to the conventional slip gap method for changing the speed of a discrete element such that it can be applied to a continuously moving web, the use of the combination of the offset drive ring **56** and the pivoting coupler arm **78** provides the ability to obtain greater changes in speed and to maintain constant speeds for a fixed duration. The fixed speed dwell achieved by using the oscillating cam adjusted roller or OSCAR module can be accurately and inexpensively designed to precisely control the length and placement of the discrete elements **52** on the second substrate web **20**. For example, the drive ring **56** and coupler arm **78** may be analytically designed such that each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** receives the discrete elements **52**, while maintaining a constant surface speed substantially equal to the speed of the first substrate web **18** and applies the discrete elements **52** to the second substrate web **20**, while maintaining a constant surface speed which is substantially equal to the speed of the second substrate web **20**.

The surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is maintained substantially constant as the discrete elements **52** are received or applied for at least about 10° of rotation and desirably at least about 20° of rotation of the respective transfer segment **54**. For example, the surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** may be maintained substantially constant as the parts are received or applied for from about 5° to about 120° of rotation, desirably from about 15° to about 90° of rotation, and more desirably from about 45° to about 60° of rotation thereof. In addition, the surface speed increase or decrease of one of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** as it moves from receiving the discrete elements **52** to applying the

discrete elements **52** and back again defines a speed ratio of from about 0.1:1 to about 0.99:1, desirably from about 0.38:1 to about 0.75:1, and more desirably, from about 0.4:1 to about 0.6:1. The term "speed ratio", as used herein, defines the ratio of the surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at the low speed dwell to the surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at the high speed dwell.

The above-described first and second embodiments of the apparatus **10** of the present invention may be used in the manufacture of absorbent articles **14**, such as infant disposable diapers, child training pants, adult incontinence garments, feminine sanitary napkins, and other products for storing fluid bodily exudates. In operation, the apparatus **10** of the present invention performs a method of separating a discrete element **52** from a pre-perforated first substrate web **18'** moving at a first speed and applying the discrete element **52** onto a second substrate web **20** moving at a second speed.

The method includes the step of making lines of perforations **42** across a width **W**, at least partially through a thickness **T**, and at predetermined spaced apart intervals along a length **L** of the first substrate web **1**. Then, the discrete element **52** is separated from the pre-perforated first substrate web **18'** along a first of the lines of perforations **42**. Once separated from the pre-perforated first substrate web **18'**, the discrete element **52** is placed or positioned on the second substrate web **20**.

The step of making the lines of perforations **42** in the first substrate web **18** concludes with a pre-perforated first substrate web **18'** being conveyed to a separation and transfer mechanism **12** having at least first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. The pre-perforated first substrate web **18'** is moved onto an outer surface **64** of first and second separation and transfer segments **54a**, **54b** and held on the outer surface **64** of first and second separation and transfer segments **54a**, **54b** by means of vacuum.

The step of separating the discrete element **52** from the pre-perforated first substrate web **18'** is done by accelerating the first separation and transfer segment **54a** away from the second separation and transfer segment **54b**, which is initially adjacent to the first separation and transfer segment **54a**, to separate the discrete

element **52** from the pre-perforated first substrate web **18'** at the first of the lines of perforations **42**.

The step of placing or positioning the discrete element **52** onto the second substrate web **20** may include one or two sub-steps. First, the separation and transfer mechanism **12** must be rotated around a central axis thereof in a range of from approximately 90° to approximately 180°. Then, after the separation and transfer mechanism is rotated, the first separation and transfer platform **54a**, which is vacuum holding the discrete element **52** thereon, may be pivoted around an axis perpendicular to the central axis of the separation and transfer mechanism **12** in order to position the discrete element **52** in its correct orientation onto the second substrate web **20**. If it is necessary to pivot the discrete element **52**, the pivoting is usually somewhere in the range of from approximately 90° to approximately 180°.

In order to have the discrete element **52** be positioned on the second substrate web **20**, a step of turning off vacuum may be needed so that the discrete element **52** is released from the outer surface **64** of the separation and transfer segment **54**.

With respect to the second embodiment of the apparatus **10** of the present invention, a further step of applying adhesive to a first, outer surface (i.e., the surface of the pre-perforated first substrate web **18'** which does not come into contact with the outer surface **64** of the separation and transfer segments **54**) of the pre-perforated first substrate web **18'** may be necessary in order to adhere the discrete element **52** to the second substrate web **20** once correctly positioned thereon. Most preferably, the step of applying adhesive would take place between the step of making the lines of perforations **42** in the first substrate web **18** and the step of separating the discrete element **52** from the pre-perforated first substrate web **18'** by means of accelerating the first separation and transfer segment **54a** to move away from the second separation and transfer segment **54b**.

Also with respect to the second embodiment of the apparatus **10** of the present invention, another step of stretching or elongated a stretchable or elastic material of the first substrate web **18** may be necessary prior to the step of making lines of perforations **42** in the first substrate web **18**, so that the discrete

element **52** of stretchable material remains stretched both after being separated from the prperforated first substrate web **18'** and after being transferred to the second substrate web **20**.

FIG. 5 generally illustrates an absorbent article **14**, such as an infant disposable diaper, a child training pant, an adult incontinence garment, a feminine sanitary napkin, and other similar products for storing fluid bodily exudates, which all have similar component parts, may be made by the method of the present invention with either of the first or second embodiment of the apparatus **10** of the present invention. More particularly, an absorbent article **14** often includes an absorbent core or insert member **16** and a liquid impermeable topsheet layer **96**. The absorbent core member **16** is composed of a substantially hydrophilic material capable of absorbing a selected liquid, such as urine or other bodily discharges. The topsheet layer **96** is superposed in facing relationship with a first major surface of the absorbent core **16**, and has an effective average pore size therein, which typically is larger than the pore size of the absorbent core **16**. A liquid permeable transport layer **98** is located between absorbent core **16** and topsheet layer **96**. The transport layer **96** is composed of a material which is less hydrophilic than the material of the absorbent core **16**, and may generally be characterized as being substantially hydrophobic. The transport layer **96** has an effective average pore size therein which is greater than the pore size of the immediately adjacent portion of the absorbent core **16**, but less than the pore size at topsheet **96**. The transport layer **98** may have a density within the range of 0.015-0.5 g/cc, and a wet compression recovery value of at least about 65%.

An absorbent article **14** often include a backsheet layer **100** and a substantially liquid permeable topsheet layer **96** superposed in facing relationship with the backsheet layer **100**. An absorbent core **16**, composed of a substantially hydrophilic material capable of absorbing a selected liquid, is located between backsheet layer **100** and topsheet layer **96**, and a liquid permeable transport layer **98**, composed of a substantially hydrophobic material, is located between topsheet **96** and absorbent core **16**. The transport layer **98** has a substantially uniform density, and a wet compression recovery value of at least about 65% in the presence of water. Backsheet **100** and topsheet **96** are often essentially coterminous and extend out past the edges of absorbent core **16** to form first or end margins **102** and second or side margins **104**. Absorbent article **14** may have waistband portions **106**

interconnected by an intermediate portion **108**. The intermediate portion **108** may be narrower than the waistband portions **106**, so that absorbent article **14** has a generally hourglass of I-shape platform with the waistband portions **106** defining ear sections **110** extending oppositely along the lateral cross-wise direction. Two ear sections **110** at one of waistband portions **106** include securement means for fastening the absorbent article **14** to the wearer thereof. The securement means may be operably connected to the back waistband portion **106** of the absorbent article **14** and comprise adhesive tape tabs **112**. It is readily apparent, however, that various other securement means, such as hooks, snaps, cohesive strips, and similar, could also be employed as fastening means. Further, leg elastic members **114** may be attached to each of the side margins **104** of the absorbent article **14**. The leg elastic members **114** may be configured so as to gather and shirr the leg band portions of the absorbent article **14** to form seals or gaskets about the legs of the wearer. Absorbent article **14** may include waist elastic members **22** secured to one or more of end margins **102** to gather and shirr the waistband portions **106** of the absorbent article **14**. The absorbent article **14** may include a generally rectangular-shaped absorbent core **16** and perforations formed through the side margins **104** of backsheet layer **100**. The perforations may have diameters up to about 0.020″ and may be arranged to provide about 100-300 perforations per square inch of backsheet area. Preferably, the perforated area is limited to the portion of the side margins **104** of the backsheet **100** located between the leg elastic member and the terminal side edge of the backsheet **100**, but may cover a greater portion or even all of the area of the backsheet **100**, if desired.

The various components of absorbent article **14** are assembled together employing conventional techniques. For example, the components may be attached to one another employing thermal or sonic bonds, or mechanical fasteners, such as snaps or clips. Alternatively, the components can be attached with adhesives, such as hot melt pressure-sensitive adhesives. The adhesives can be applied by employing conventional techniques, such as spraying droplets or filaments of adhesive. Preferably, the components are assembled employing a plurality of generally parallel lines of hot melt pressure-sensitive adhesive oriented along the length dimension of the absorbent article **14**.

Backsheet **100** may be composed of liquid impermeable material, such as polymer film. For example, backsheet **100** can be composed of a polyolefin film, such as

polyethylene or polypropylene. Backsheet **100** can also be composed of a liquid impermeable, but vapor permeable material, such as breathable, micro-porous polyethylene film, or the backsheet **100** can be composed of a vapor permeable, non-woven fibrous material which has been suitably treated to impart a desired degree of liquid impermeability. For example, the backsheet **100** may be comprised of a non-woven spunbounded layer which has been completely or partially coated with a polymer film to provide liquid impermeability in particular areas.

Topsheet **96** is typically composed of a liquid permeable, substantially hydrophobic fibrous material, such as a spunbonded web composed of synthetic polymer filaments. Alternatively, topsheet **96** may comprise a meltblown web or a bonded-carded-web composed of synthetic polymer filaments. Suitable synthetic polymers include, for example, polyethylene, polypropylene, and polyesters. The polymer filaments generally have a denier within the range of about 1.5-7, and preferably have a denier within the range of about 1.5-3. The filaments are arranged to form a layer having a basis weight with the range of about 0.6-1.0 oz/yd^2 (osy), and preferably a basis weight of about 0.8 osy. In addition, the topsheet layer **96** has a bulk thickness with the range of about 0.008-0.017", and preferably a bulk thickness within the range of about 0.010-0.012" for improved effectiveness. The bulk thickness is measured under a restraining pressure of 0.014". The topsheet **96** has a pore size that readily allows the passage therethrough of liquids, such as urine and other bodily exudates. A typical topsheet **96** may have an effective average pore size, in terms of equivalent circular diameter (ECD), which is within the range of about 40-110 μm, and preferably within the range of about 70-110 μm to provide improved effectiveness.

The topsheet **96** can optionally be treated with surfactants to adjust the degree of hydrophobicity and wettability, and can also be selectively embossed or apertured with discrete slits or holes extending therethrough. When configures with apertures, the apertures may substantially define the effective pore size of the topsheet **96**. The apertures have an average equivalent diameter within the range of about 138-350 μm and preferably have an average diameter of about 250 μm to provide improved performance. Thus, the topsheet **96** would again have a pore size which is larger than the pore size of transport layer **98**.

Absorbent core **16** typically comprises a pad composed of airlaid cellulosic fibers commonly referred to as wood pulp fluff. Conventional pads can have a

density ranging from about 0.05-0.20 g/cc, and are sufficiently flexible to readily conform to the body of the wearer. Absorbent core **16** may also comprise a co-form material composed of a mixture of cellulosic fibers and synthetic polymer fibers. For example, the co-form material may comprise an airlaid blend of cellulosic fibers and meltblown polyolefin fibers, such as polyethylene and polypropylene fibers. The fibrous material comprising absorbent core **16** may be composed of filaments having a coarseness of about 10-20 mg per 100 m, and preferably having a coarseness within the range of about 10-18 mg per 100 m. The filaments are arranged to form a layer having a basis weight within the range of about 400-1200 g/m^2 and preferably a basis weight of about 800 g/m^2. In addition, the material of absorbent core **16** has a bulk thickness within the range of about 0.17-0.21", as measured under a restraining pressure of 0.068 psi.

Absorbent core **16** may also include an effective amount of an inorganic or organic high-absorbency material to enhance the absorptive capacity of the absorbent core **16**. For example, absorbent core **16** can include 5-95 wt % high-absorbency material, and preferably includes about 10-30 wt % of the high-absorbency material to provide more efficient performance. Suitable inorganic high-absorbency materials can include, for example, absorbent clays and silica gels. Organic high-absorbency materials can include natural materials, such as agar, pectin, guar gum, and peat moss, as well as synthetic materials, such as synthetic hydrogel polymers. Such hydrogel polymers include, for example, carboxymethylcellulose, alkali metal salts of polyacrylic acids, polyacrylamides, polyvinyl alcohol, ethylene maleic anhydride copolymers, polyvinyl ethers, hydroxypropyl cellulose, polyvinyl morpholinone, polymers and copolymers of vinyl sulfonic acid, polyacrylates, polyacrylamides, polyvinyl pyridine and similar. Other suitable polymers include hydrolyzed acrylonitrile grafted starch, acrylic grafted starch, and isobutylene maleic anhydride copolymers, and mixtures thereof. The hydrogel polymers are preferably lightly cross-linked to render the material substantially water-insoluble. Cross-linking may, for example, be by irradiation or by covalent, ionic, Van der Waals, or hydrogen bonding. Suitable materials are available from various commercial vendors, such as Dow Chemical Company, Celanese Corporation, Allied-Colloid, and Stockhausen. Typically, the high-absorbency material is capable of absorbing at least about 15 times its weight in water, and preferably is capable of absorbing at least about 25-50 times its weight in water.

The high-absorbency material can be distributed or otherwise incorporated into absorbent core **16** employing various techniques. For example, the high-absorbency material can be substantially uniformly distributed in the mass of fibers comprising the absorbent core **16**. The material can also be non-uniformly distributed among the fibers to form, for example, a generally continuous gradient with either an increasing or decreasing concentration of high-absorbency material, as determined by observing the concentration moving from the body-side of absorbent core **16** to the outer-side of the absorbent core **16**. Alternatively, the high-absorbency material can comprise one or more discrete layers or strips selectively segregated from the fibrous material of absorbent core **16**.

The apparatus **10** can be used to apply elongated elastic parts to the waist opening regions on a product web of interconnected disposable diapers as will be described with respect to the second embodiment of the present invention. For example, a continuously moving first substrate web **18** of elongated elastic material is perforated and then separated at the junction of adjacent ones of first, second, and third separation and transfer segments **54a**, **54b**, and **54c**. The web of elastic material may be elongated at least about 150% and desirably from about 150% to about 400% before being perforated and separated. The discrete elongated elastic elements **52** are held onto the outer surface **64** of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** as it rotates in the elongated state by the surface roughness of the outer surface **64**. In a particular aspect, the discrete elongated elastic elements **52** are maintained at an elongation of at least about 125%, desirably at least about 150%, and more desirably from about 150% to about 400% until they are applied to the product web **20**. In addition, a relatively low level of vacuum may also be drawn through holes in the outer surface **64** to assist the surface roughness in maintaining the discrete elongated elastic elements **52** in the elongated state.

The combination of the offset drive ring **56** and the pivoting coupler arm **78** are rotated by the drive means which, in turn, rotates each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** at the desired variable speed with fixed speed dwells. As each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is rotated, the outer surface **64** thereof maintains a substantially constant speed as the discrete elongated elastic elements **52** are received and applied. In particular, each of first, second, and third

separation and transfer segments **54a**, **54b**, and **54c** receives the discrete elongated elastic elements **52**, while maintaining a constant surface speed substantially equal to the speed of the first substrate web **18** of discrete elongated elastic elements **52** prior to separation. The surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** then changes to a second constant surface speed such that the speed of the discrete elongated elastic elements **52** being transferred is substantially equal to the speed of the continuously moving product web of interconnected diapers as the discrete elongated elastic elements **52** are applied to the waist opening regions on each diaper. The surface speed of each of first, second, and third separation and transfer segments **54a**, **54b**, and **54c** is then changed back to substantially equal the speed of the first substrate web **18** of discrete elongated elastic material elements **52** before the next discrete elongated elastic element **52** is received.

The discrete elongated elastic elements **52** being applied to the second substrate web **20** of interconnected diapers may be made of any suitable material having elastic or stretchable properties. Examples of such materials include films or layers of natural rubber, synthetic rubber, or thermoplastic elastomeric polymers, and can be panels, or single, or multiple threads or filaments or ribbons thereof. These materials may also be heat-shrinkable or heat-elasticizable.

Furthermore, these stretchable materials may be formed with gatherable layers, such as spunbonded polymer materials, as a stretch-bonded laminate. For example, a suitable stretch-bonded laminate comprise two gatherable layers of 0.04 osy of spunbond polypropylene having therebetween a layer of meltblown elastic material such as a Kraton elastic in either layer form or separate threads of material having a basis weight of about 0.50 osy. The layer of the elastomeric is stretched, the two layers of polypropylene then joined to the elastomeric layer, and upon relaxing the layers, the polypropylene layers gather. The materials may be breathable or non-breathable.

Although the above representative example concerns the application of leg elastic to a diaper, it should be readily apparent to those of ordinary skill in the art that the present invention may be utilized in any circumstance requiring speed variations and constant speed dwells when transferring parts onto a moving web.

While the invention has been described in detail with respect to specific aspects thereof, it will be appreciated that those skilled in the art upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these aspects. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

We claim:

1. An apparatus for separating a discrete element from a first substrate web moving at a first speed and applying said discrete element onto a second substrate web moving at a second speed, said apparatus comprising:

a first station for making lines of perforations across a width, at least partially through a thickness, and at predetermined spaced apart intervals along a length of said first substrate web; and

a second station for separating said discrete element from said first substrate web at a first of said lines of perforations and placing said discrete element on said second substrate web.

2. The apparatus of claim 1, wherein said first station includes a perforation cutter assembly having first and second rollers, said first roller having least one anvil-type member with a flat cutting surface for being cut against, said at least one anvil-type member being partially embedded in and having said flat cutting surface extending radially outwardly from an outer circumferential surface of said first roller, and said second roller having at least one discontinuous cutting blade extending from an outer circumferential surface thereof, whereby said first and second rollers are timed to rotate so that said at least one cutting blade contacts said flat cutting surface of said at least one anvil-type member to make said lines of perforations at said spaced intervals along said length of said first substrate web to form said pre-perforated first substrate web.

3. The apparatus of claim 2, wherein said at least one discontinuous cutting blade comprises a rectangular metal plate having two long sides, each long side having a discontinuous cutting edge.

4. The apparatus of claim 3, wherein said first station further includes a conveyor assembly for conveying said pre-perforated first substrate web from said perforation assembly to said second station.

5. The apparatus of claim 2, further comprising a web guide located prior to said second station, wherein said web guide keeps said first substrate web centered during operation of said apparatus.

6. The apparatus of claim 1, wherein said second station includes a separation and transfer mechanism having at least one separation and transfer segment for separating and transferring said discrete element from said pre-perforated first substrate web to said second substrate web.

7. The apparatus of claim 6, wherein said at least one separation and transfer segment includes first, second, and third separation and transfer segments.

8. The apparatus of claim 7, wherein said first, second, and third separation and transfer segments each include a holding means for holding said pre-perforated first substrate web against an outer surface thereof and for holding said discrete element, once separated from said pre-perforated first substrate web, against an outer surface thereof.

9. The apparatus of claim 8, wherein said holding means is vacuum assisted.

10. The apparatus of claim 1, further comprising an adhesive applicator assembly for applying adhesive to a first surface of said first substrate web in order for said discrete element separated from said first substrate web to be adhered to said second substrate web.

11. The apparatus of claim 10, wherein said adhesive applicator assembly for applying adhesive to said first surface of said first substrate web is preferably located between said first and second stations.

12. The apparatus of claim 1, wherein said first substrate web comprises stretchable material which has been stretched prior to entering said first station so that both said discrete element and said first substrate web remain stretched after said discrete element is separated from said first substrate web and after

said discrete element is transferred from said second station onto said second substrate web.

13. A method of separating a discrete element from a first substrate web moving at a first speed and applying said discrete element onto a second substrate web moving at a second speed, said method comprising the steps of:

making lines of perforations across a width, at least partially through a thickness, and at predetermined spaced apart intervals along a length of said first substrate web;

separating said discrete element from said first substrate web along a first of said lines of perforations; and

placing said discrete element on said second substrate web.

14. The method of claim 13, wherein making said lines of perforations in said first substrate web forms a pre-perforated first substrate web for transport to a separation and transfer mechanism having at least first, second, and third separation and transfer segments.

15. The method of claim 14, wherein moving said pre-perforated first substrate web onto an outer surface of said first and second separation and transfer segments occurs between making said lines of perforation and separating said discrete element.

16. The method of claim 15, wherein vacuum holding of said pre-perforated first substrate web onto said outer surface of said first and second separation and transfer segments is accomplished after moving said pre-perforated first substrate web onto said first and second separation and transfer segments.

17. The method of claim 16, wherein separating said discrete element from said first substrate web at said first of said lines of perforations is done by accelerating said first separation and transfer segment so that said first separation and transfer segment moves away from said second separation and transfer segment, which is initially adjacent to said first separation and transfer segment.

18. The method of claim 17, wherein placing said discrete element includes rotating said separation and transfer mechanism around a central axis thereof in a range of from approximately 90 degrees to approximately 180 degrees.

19. The method of claim 18, wherein after said separation and transfer mechanism is rotated, pivoting said first separation and transfer platform vacuum holding said discrete element thereon around an axis perpendicular to said central axis of said separation and transfer mechanism, said pivoting being in a range of from approximately 90 degrees to approximately 180 degrees.

20. The method of claim 19, further comprising releasing vacuum so that said discrete piece vacuumed adhered to said first separation and transfer platform can be placed on said second substrate web.

21. The method of claim 13, further comprising between making said lines of perforations and separating said discrete element, applying adhesive to a first surface of said first substrate web.

22. The method of claim 13, wherein prior to making lines of perforations in said first substrate web, stretching a stretchable material of said first substrate web so that said stretchable material of both said discrete element and said first substrate web remains stretched after said discrete element is separated from said first substrate web and said discrete element is transferred to said second substrate web.

23. The method of claim 13, wherein making said lines of perforation includes entirely cutting through said thickness of said first substrate web.

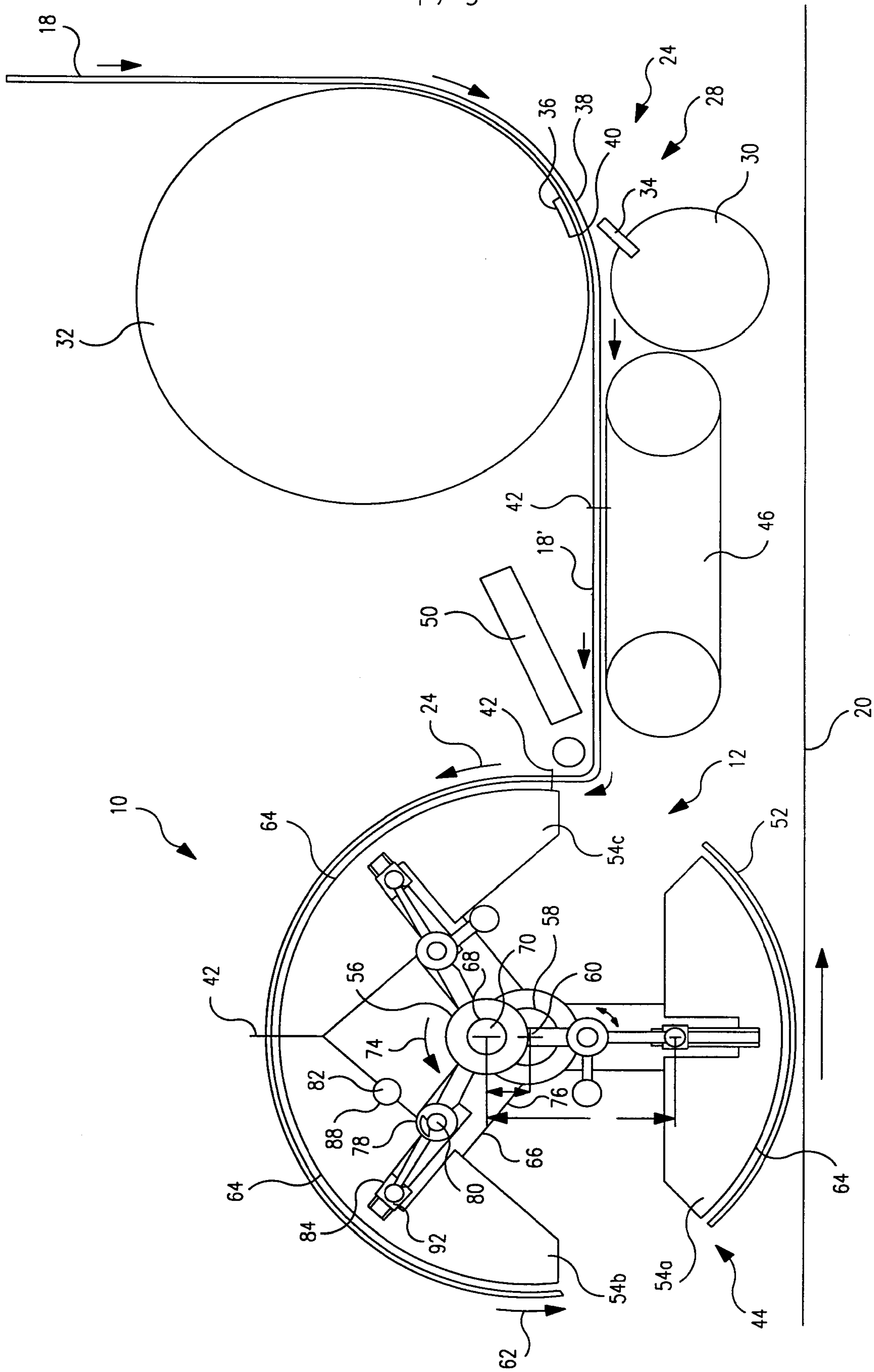
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FIG. 1

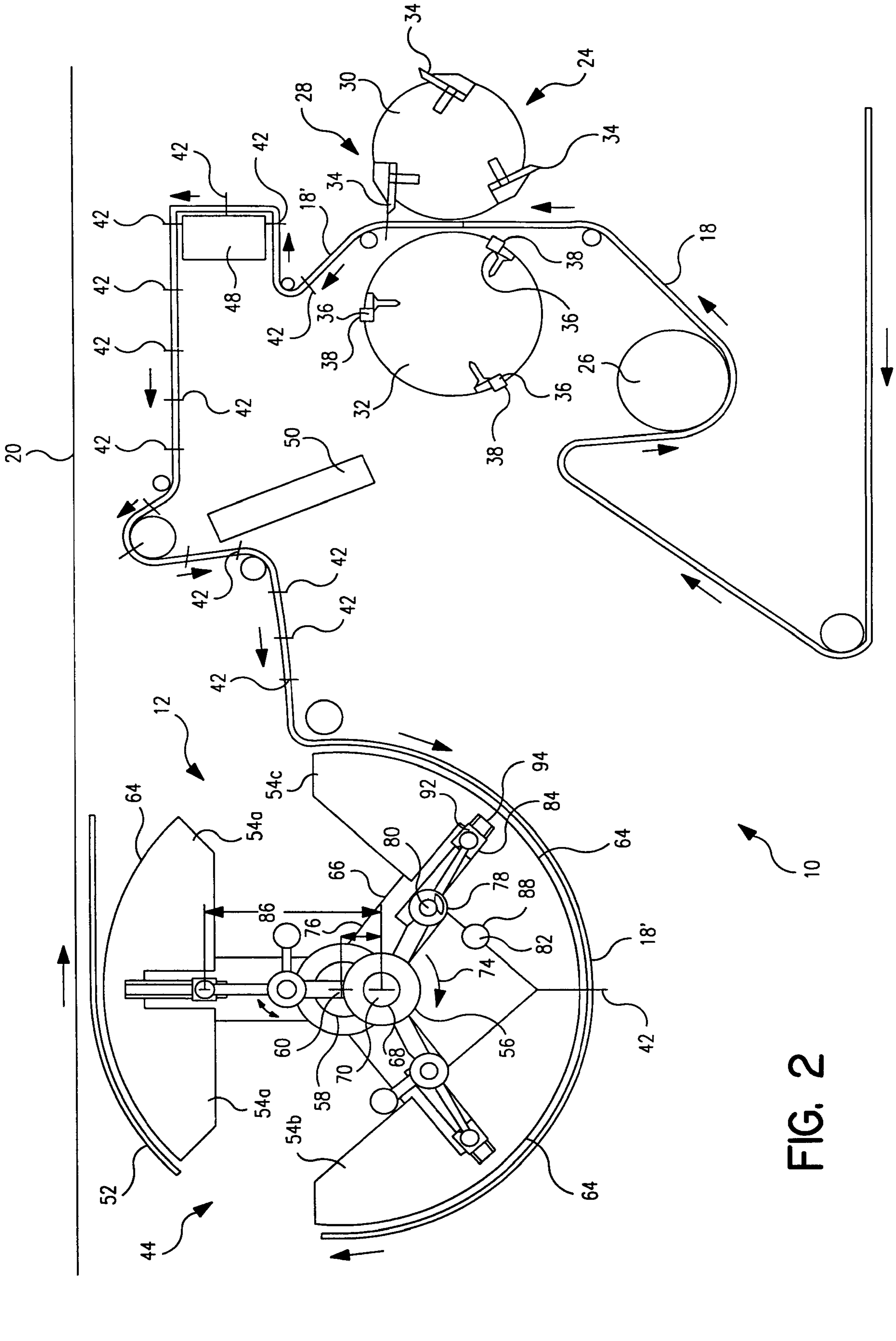
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FIG. 2

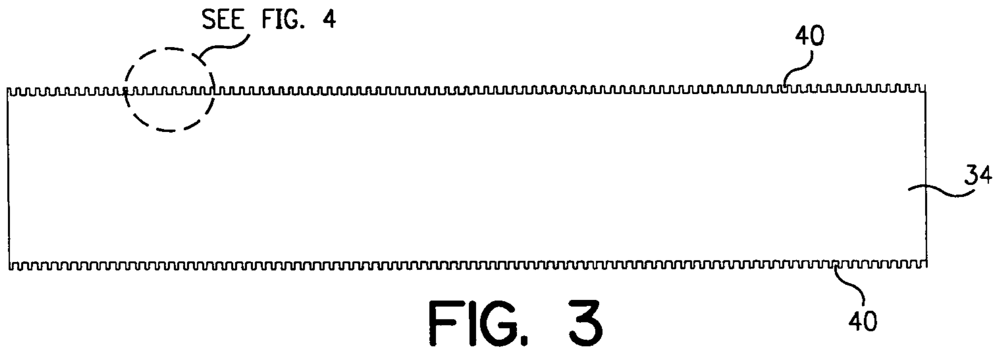

FIG. 3

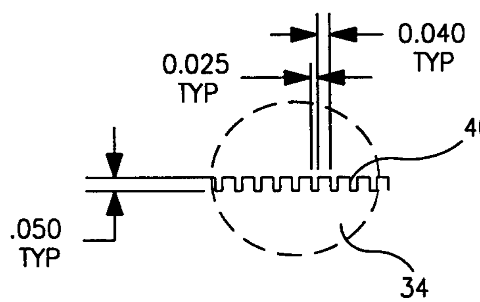

FIG. 4

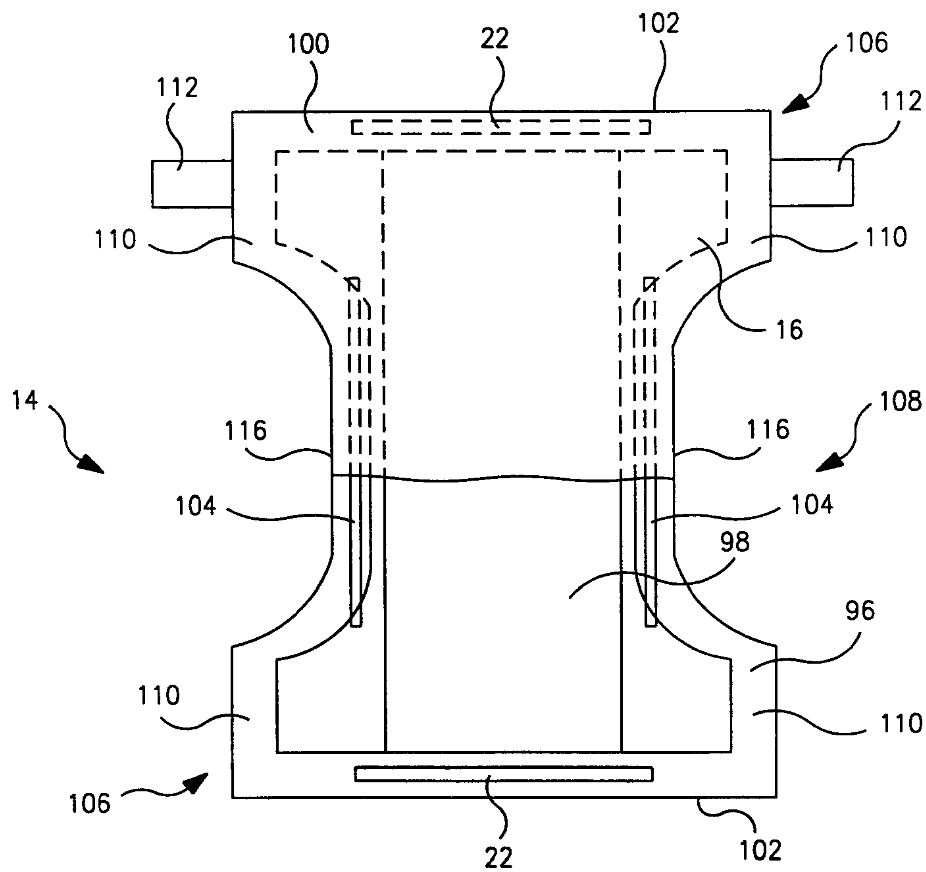

FIG. 5

INTERNATIONAL SEARCH REPORT

Interna. . Application No
PCT/US 00/24360

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F13/15 F16H35/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F F16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 061 527 A (TRAISE JOHN E) 6 December 1977 (1977-12-06) column 2, line 51 -column 3, line 12; figures 1,2	1-23
Y	US 5 716 478 A (BOOTHE JUDSON LAMAR ET AL) 10 February 1998 (1998-02-10) cited in the application abstract; figure 1	1-23
A	US 4 726 876 A (TOMSOVIC JR JAMES E) 23 February 1988 (1988-02-23)	
A	CH 268 984 A (INT CELLUCOTTON PRODUCTS COMPA) 15 June 1950 (1950-06-15)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 November 2000	01/12/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Soederberg, J

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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